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ABSTRACT

Two methods are presented for extending Holland's occupational classification to include all occupations in the Dictionary of Occupational Titles (DOT). Holland's classification is based on a theory of personality types, with occupations in the classification organized into major categories (Realistic, Investigative, Artistic, Social, Enterprising, and Conventional) and subcategories using the same concepts. The two conversion methods enable translation from any DOT occupational code (a six digit number) into the corresponding Holland Occupational code. The first method is essentially an application of Bayesian statistics to 399 occupations in Holland's Occupational Classification, while the second method was developed by using the definitions of each DOT group (first three DOT digits) and assigning the Holland code which seems theoretically consistent with the DOT definition. Testing and comparisons with four occupational samples revealed that Holland's classification could be extended to all DOT occupations. (Author)

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THE EXTENSION OF HOLLAND'S OCCUPATIONAL CLASSIFICATION TO ALL OCCUPATIONS IN THE DICTIONARY OF OCCUPATIONAL TITLES

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Mary Cowan Viernstein

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INTRODUCTORY STATEMENT

The Center for Social Organization of Schools has two primary objectives: to develop a scientific knowledge of how schools affect their students, and to use this knowledge to develop better school practices and organization.

The Center works through five programs to achieve its objectives. The Academic Games program has developed simulation games for use in the classroom, and is studying the processes through which games teach and evaluating the effects of games on student learning. The Social Accounts program is examining how a student's education affects his actual occupational attainment, and how education results in different vocational outcomes for blacks and whites. The Talents and Competencies program is studying the effects of educational experience on a wide range of human talents, competencies and personal dispositions, in order to formulate -- and research -- important educational goals other than traditional academic achievement. The School Organization program is currently concerned with the effects of student participation in social and educational decision making, the structure of competition and cooperation, formal reward systems, ability-grouping in schools, effects of school quality, and applications of expectation theory in the schools. The Careers and Curricula program bases its work upon a theory of career development. It has developed a self-administered vocational guidance device to promote vocational development and to foster satisfying curricular decisions for high school, college, and adult populations.

This report, prepared by the Careers and Curricula program, extends Holland's Occupational Classification to include all occupations in the Dictionary of Occupational Titles (DOT), allowing the Holland classification to be applied to a greater range of practical and theoretical situations.

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ABSTRACT

Two methods are presented for extending Holland's occupational classification to include all occupations in the Dictionary of Occupational Titles (DOT).

Holland's classification is based on a theory of personality types; occupations in the classification are organized into six major categories (Realistic, Investigative, Artistic, Social, Enterprising, and Conventional) and subcategories using the same concepts.

The methods given in this article enable translation from any DOT occupational code (a six digit number) into the corresponding Holland occupational code.

The first method is essentially an application of Bayesian statistics to 399 occupations in Holland's Occupational Classification. The second method was developed by using the definitions of each DOT group (first three DOT digits) and assigning the Holland code which seems theoretically consistent with the DOT definition.

The conversion methods are tested and compared on four occupational samples. An evaluation of the usefulness of the methods is given.

Introduction

Holland and his colleagues have proposed, tested, and revised an occupational classification based on a theory of vocational choice (Holland, 1959; 1966b; Holland, Whitney, Cole, and Richards, Jr., 1969; Holland, Viernstein, Kuo, Karweit, and Blum, 1970). The classification organizes occupations into six major categories (Realistic, Investigative, Artistic, Social, Enterprising, and Conventional) and subcategories using the same concepts. The theory of vocational choice, which led to the development of the classification, provides interpretations of membership in the various categories.

This paper presents two methods for extending Holland's occupational classification to include all occupations in the Dictionary of Occupational Titles (DOT). Converting DOT codes into the equivalent Holland codes will allow the Holland classification and its closely related theory to be applied to a greater range of practical and theoretical situations, and will provide more psychological information about occupations in the DOT.

Holland's theory of vocational choice (1959, 1966a, 1966b) assumes that it is useful to assess people in terms of six personality types: Realistic, Investigative, Artistic, Social, Enterprising and Conventional. Corresponding to these types are six characteristic work environments: Realistic (technical, skilled and laboring occupations), Investigative (scientific occupations), Artistic (literary and musical occupations), Social (educational and social welfare occupations), Enterprising (sales and managerial occupations) and Conventional (office and clerical occupations). In the occupational classification

(1968b, 1969, 1970), each occupation is designated by an ordered arrangement of three letters. These letters indicate the components, in order of importance, which describe the people in that occupation. For example, a physicist is designated as IAR; thus physicists are described as primarily Investigative, secondarily Artistic, and thirdly Realistic. A person's performances, such as vocational achievement or job stability, are assumed to depend upon the congruity of his personality type and his work environment. Thus, for example, an Investigative-Artistic-Realistic (IAR) person should do best in one of the IAR occupations, such as physicist.

The third edition of the Dictionary of Occupational Titles (1965) classifies over 22,000 separate occupations which, due to redundancy, are known by approximately 40,000 titles. The DOT classification is made in terms of work performed and worker trait requirements. Each occupation is identified by its DOT code, which is a six-digit number. The value of the first DOT digit indicates the broad category to which an occupation belongs, e.g., Professional, Clerical, Service. The second digit places an occupation within a broad subject matter, or type of activity, e.g., occupations in Medicine and Health, or Salesmen. The third digit gives a more specific job description, e.g., Osteopath or Salesmen and Salespersons in Housefurnishings. DOT digits four, five and six describe the worker's functioning in relation to data, people and things, respectively.

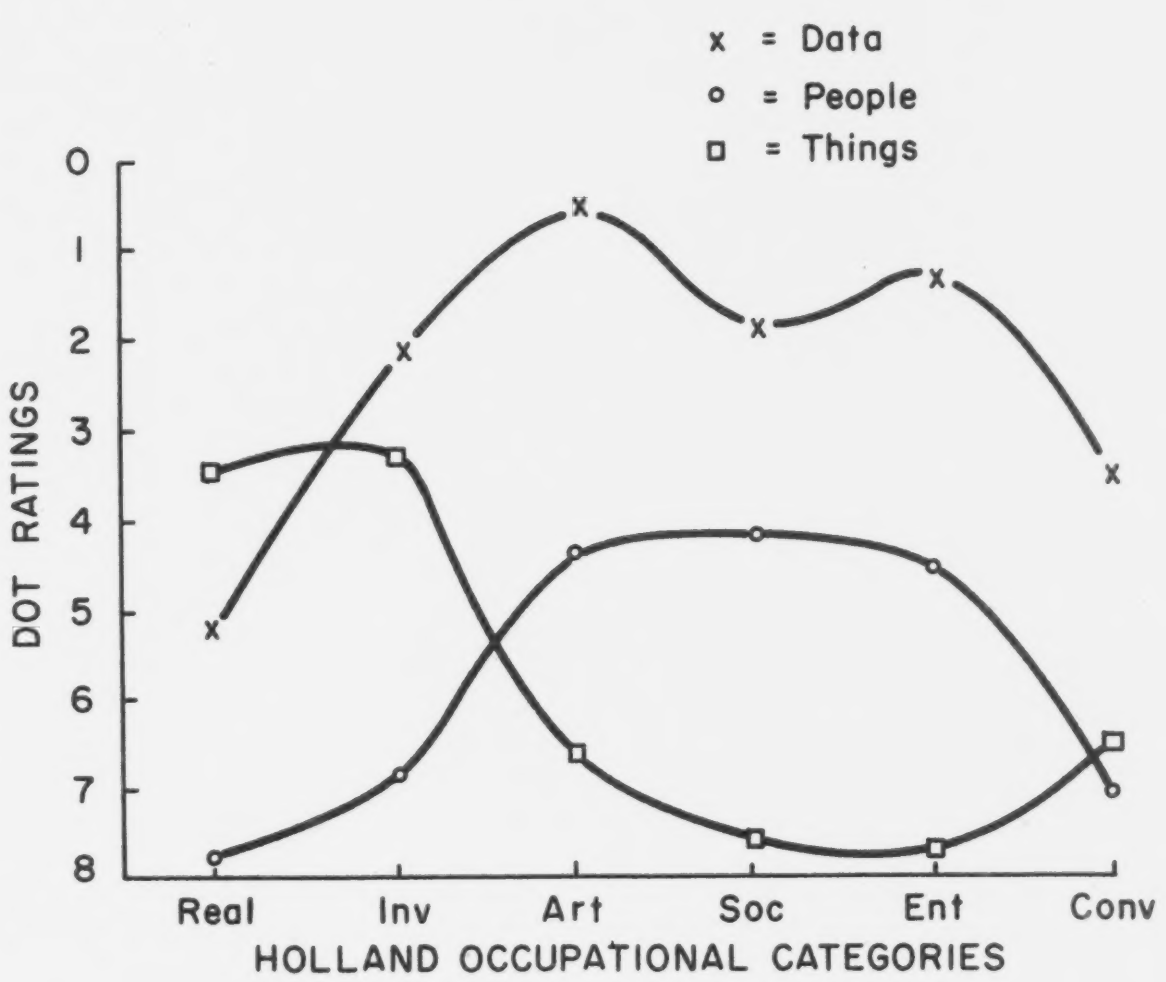
Substantial relationships between the Holland occupational categories and the DOT code were found previously (Holland et al, 1970). These findings suggested that a method of translation from the DOT

number to the appropriate Holland code might be possible.

Initially, relationships were found between the Holland occupational categories and the values of the last three digits of the DOT number. The fourth DOT digit represents the degree of involvement in data required for an occupation. An occupation having a fourth DOT digit of "0" requires a high level of skilled involvement with data, whereas a value of "8" means that the occupation has no significant involvement in the handling of data. Similarly, the fifth and sixth digits describe the levels of complexity of the job in terms of people and things, respectively. For example, the DOT code for Dancing Teacher, 151.028, indicates that the involvement with data is high (0), with people is high (2), but with things is low (8). Figure 1 shows how each of the Holland categories is related to the mean DOT digit values (fourth, fifth and sixth DOT digits only) for 417 occupations (Holland et al, 1970). The mean DOT numbers for Holland categories, as shown on the graph, are consistent with definitions of Holland's occupational categories. For example, Figure 1 shows that for Realistic and Investigative types of persons, the involvement with things is high -- on the order of 3.5 -- whereas it is much lower -- on the order of 7.5 -- for the other types. Also the involvement with people is higher for Artistic, Social and Enterprising types than for Realistic, Investigative and Conventional types.

Figure 1

The Relation of the Holland Occupational Categories to Levels of Talent for Coping with Data, People, and Things (DOT)



		Real	Inv	Art	Soc	Ent	Conv
Data:							
	X	5.2	2.1	0.5	1.9	1.3	3.5
	S.D.	2.7	2.2	0.9	1.6	1.3	2.1
People:							
	X	7.7	6.8	4.3	4.2	4.5	7.1
	S.D.	0.9	2.7	2.2	2.1	2.5	1.4
Things:							
	X	3.4	3.2	6.6	7.5	7.7	6.5
	S.D.	2.7	3.1	2.7	1.0	1.4	2.5
Number of Occupations		139	95	20	70	50	43

Converting DOT Codes into Holland Codes

Two methods were developed for converting DOT codes into Holland codes. The first method uses a frequency table of DOT digits obtained from all DOT codes for jobs in the Holland Occupational Classification (Holland et al, 1970). This method is essentially an application of Bayesian statistics, which calculates probabilities for the purpose of placing the DOT code of a particular occupation into one of the six Holland categories. The categories corresponding to the three highest probabilities become the Holland code.

The second method was developed by using the definitions of each DOT group (first three DOT digits) and assigning the Holland code which seems theoretically consistent with the DOT definition. For example, any DOT number with the first three digits 001 refers to Architectural occupations in the Dictionary of Occupational Titles, and is thus assigned to the Artistic category of Holland's classification.

Method I. The first three digits in a DOT code refer to occupational categories, whereas the last three digits represent the degree of involvement with data, people and things required by an occupation. Since Method I utilizes the probability of finding a particular DOT code in each of the Holland categories, it was necessary to determine the frequency with which each of the values of the digits of the DOT code occurs in all six Holland categories. For this purpose, the DOT codes for the 399 occupations listed in the most recent version of the Holland Occupational Classification (Holland,

1971, unpublished) were compiled. The frequency of occurrence of the digits was computed, and normalized tables for the Holland categories were formed. The normalized frequencies for the 10 values (0-9) of the first three digits -- those refering to occupational categories -- are shown in Table 1. The normalized frequencies for the 9 values (0-8) of the last three digits -- those refering to involvement with data, people and things -- are presented in Table 2.

It was assumed that the 399 occupations were a representative sample from the DOT so that the frequencies presented in Tables 1 and 2 represent the frequencies which would be obtained if all occupations in the DOT were included.

Before using the frequencies in Tables 1 and 2 to estimate the probability of occurrence of a given DOT code in the various Holland categories, it was necessary to obtain an estimate of the percentage of Realistic, Investigative, etc. occupations in the DOT. This was done by randomly choosing 300 occupations from the DOT and having the occupations classified into Holland's categories. (The classifications of three raters working independently showed 90.1% agreement.) In this sample of occupations, 81.5% were Realistic occupations, 5.0% Investigative, 1.7% Artistic, 2.0% Social, 6.0% Enterprising and 3.7% Conventional.

An example will illustrate how the frequencies in Tables 1 and 2 and the estimated percentages of the six Holland classes in the DOT were used to compute the necessary probabilities and to produce the translation from the DOT code to the Holland code. If the DOT code for a given occupation (artist) is 144.081, the Realistic component

Table 1

Frequency of First Three DOT Digits in 399 Occupations from Holland's Occupational Classification

Normalized Frequencies

REALISTIC N=150 (no. of occupations)

Digit Value	DIGITS 1st	2nd	3rd
0	.087	.160	.187
1	.020	.233	.133
2	.047	.160	.120
3	.093	.073	.147
4	.020	.040	.067
5	.067	.093	.073
6	.253	.073	.047
7	.060	.047	.053
8	.180	.060	.073
9	.173	.060	.100

INVESTIGATIVE N=63

Digit Value	DIGITS 1st	2nd	3rd
0	.841	.159	.206
1	.048	.111	.222
2	.016	.254	.111
3	.001	.001	.079
4	.001	.159	.048
5	.001	.016	.048
6	.032	.001	.016
7	.063	.222	.063
8	.001	.001	.063
9	.001	.079	.143

ARTISTIC N=27

0	.148	.037	.222
1	.704	.001	.148
2	.074	.001	.259
3	.001	.148	.074
4	.001	.185	.074
5	.001	.259	.037
6	.001	.111	.001
7	.001	.074	.074
8	.001	.001	.037
9	.074	.185	.074

SOCIAL N=68

0	.412	.029	.044
1	.397	.044	.147
2	.074	.044	.059
3	.103	.015	.029
4	.001	.059	.044
5	.001	.118	.162
6	.001	.162	.132
7	.001	.162	.088
8	.001	.103	.103
9	.015	.265	.191

ENTERPRISING N=52

0	.192	.058	.135
1	.538	.135	.077
2	.154	.001	.192
3	.019	.001	.038
4	.019	.019	.077
5	.001	.135	.077
6	.001	.250	.192
7	.001	.019	.077
8	.019	.231	.019
9	.058	.154	.115

CONVENTIONAL N=39

0	.077	.308	.103
1	.077	.410	.154
2	.769	.026	.128
3	.001	.077	.128
4	.001	.051	.001
5	.001	.001	.154
6	.001	.077	.051
7	.026	.001	.077
8	.001	.026	.026
9	.051	.026	.179

Table 2

Frequency of Last Three DOT Digits in 399 Occupations
from Holland's Occupational Classification

Normalized Frequencies

REALISTIC N=150 (no. of occupations)				INVESTIGATIVE N=63			
	DIGITS				DIGITS		
Digit Value	4th	5th	6th	Digit Value	4th	5th	6th
0	.027	.001	.067	0	.429	.159	.016
1	.060	.001	.327	1	.238	.001	.587
2	.213	.013	.127	2	.206	.048	.016
3	.213	.007	.087	3	.127	.001	.016
4	.013	.001	.087	4	.001	.001	.016
5	.013	.001	.047	5	.001	.001	.001
6	.007	.087	.007	6	.001	.016	.001
7	.147	.033	.140	7	.001	.001	.001
8	.307	.860	.113	8	.001	.778	.349
ARTISTIC N=27				SOCIAL N=68			
0	.630	.001	.001	0	.074	.103	.001
1	.037	.001	.222	1	.515	.162	.015
2	.222	.296	.074	2	.235	.176	.001
3	.074	.037	.001	3	.132	.029	.001
4	.001	.111	.001	4	.001	.015	.001
5	.001	.037	.001	5	.001	.029	.001
6	.001	.259	.001	6	.001	.235	.001
7	.001	.001	.001	7	.001	.147	.029
8	.037	.259	.704	8	.044	.103	.956
ENTERPRISING N=52				CONVENTIONAL N=39			
0	.058	.001	.001	0	.001	.001	.001
1	.731	.269	.038	1	.128	.001	.001
2	.096	.001	.001	2	.026	.026	.154
3	.038	.077	.019	3	.513	.001	.001
4	.058	.019	.001	4	.128	.001	.001
5	.001	.154	.001	5	.077	.001	.001
6	.001	.288	.001	6	.026	.359	.001
7	.001	.038	.019	7	.077	.001	.001
8	.019	.154	.923	8	.026	.615	.846

of 144.081 equals the product of the frequencies of 1 in the first column, times 4 in the second column, times 4 in the third column, times 0 in the fourth, 8 in the fifth, and 1 in the sixth column, times the Realistic factor .815. (See Tables 1 and 2.)[1] The result (in terms of normalized frequencies) is (.020 x .040 x .067 x .027 x .860 x .327) x .815 = 3.32×10^{-7}. Similarly, the I, A, S, E, and C components are 7.18×10^{-5}, 3.49×10^{-4}, 1.18×10^{-7}, 2.67×10^{-7} and 2.42×10^{-12}, respectively.[2] The Holland components in decreasing numerical order are then AIRESC, and the Holland three-letter code for artist is AIR.

Method II. This method is based on the fact that the first three digits of the DOT code designate broad occupational categories that can be conceptually related to the work environments described by the Holland code. Each DOT group, as defined in the Dictionary of Occupational Titles, has been assigned to one of Holland's six occupational categories by using the theoretical definitions of the categories. For example, DOT groups numbered 141 through 149 are Occupations in Art, and have been assigned to the Artistic category. The 417 occupations in the Holland Occupational Classification (Holland et al, 1970) were assigned in this way, and the discrepancies between the resultant codes and the codes in the classification were

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[1] Zeros (.000 notations) in the frequency table were changed to .001 in order to reduce the number of "0" products.

[2] The mathematical reader will recognize that these values are not statements of probabilities. The denominators for the six factors are omitted, because they are all the same and thus do not change the ordering of the factors. The resulting numbers, while not probabilities, can be used to assess the relative probability of finding a given occupation in each of the six Holland categories. The assumption is made that the individual digits in a given DOT number are independent.

examined. For example, the DOT group 045 is described as "Occupations in Psychology," and was originally rated Investigative. However, it was seen that there were five 045 occupations which were categorized as Social rather than Investigative in Holland's classification. Moreover, these discrepant occupations (e.g., Counselor, Industrial Nurse) were definitely Social, according to the definitions of the types (Holland, 1966b). There was only one 045 occupation classified in Holland's Investigative category: Psychologist. Since this occupation has a strong Social component and all the other 045 occupations are clearly Social, the 045 group was rated as Social. Similar rational analyses of all discrepancies were made with the aim of improving the translations.

Occupations from the revised classification (Holland, 1971, unpublished) and from an earlier ACT report (Holland et al, 1969) were used for further refinement of the translations. (An ACT occupation was used only if the corresponding first letter of the Holland code was identical to that of the same occupation listed in the 1971 Holland Classification, or if the occupation was not listed in the classification.) The resulting conversion from DOT occupational groups to first-letter Holland codes is shown in Table 3.

Table 4 shows an extension of Method II to yield three-letter Holland codes for each DOT occupational group. The method was extended by grouping the three-letter code for each of the 399 occupations from the 1971 Holland classification under the first three digits of the DOT number (the DOT group). The three letters which occurred most frequently in each DOT group became the three-letter

Table 3

DOT Groups (first three DOT digits) and Corresponding First-letter Holland Occupational Codes

DOT Groups	HOC	DOT Groups	HOC	DOT Groups	HOC
001	A	11	E	280	E
2	I			1	E
3	I	12	S	2	E
5	R			3	S
6	I	13	A	4	E
7	R			5	E
8	I	14	A	6	E
				7	E
010	R	15	A except 153S	9	E
1	I				
2	E			29	E except 298A
3	R	160	C		
4	R	1	C		
5	I	2	E	30	R
7	R	3	E		
8	R	4	A	310	S
9	R	5	A	1	R
		6	S	2	S
020	I	8	S	3-9	R
		9	E		
040	R			32	S
1	I	18	E except 187S		
5	S			330	R
9	I			1	S
		191	E	2	S
050	E	3	R	3	A
1	S	4	R	4	S
2	S	5	S	5	S
4	S	6	I	8	S
5	I	7	E	9	S
9	S	8	R		
		9	I	34	R
070	I				
1	I			35	S except 350, 351, 352E
2	I	20-24	C except 222-224R, 233R, 239R, 240R, 241S		
3	I				
4	I				
5	S				
7	S			36-95	R except 722I
8	I				
9	S			960	R
09	S	25	E	961-97	A except 973, 974, 975, 977R
10	S	26-27	S		

NOTE: Teachers are assigned a code related to the subject they teach; e.g. Mathematics Teacher has DOT number 091.228, but preferably should be coded using the DOT number for Mathematics, 020.088.

Table 4

DOT Groups (first three DOT digits) and Corresponding 3-letter Holland Occupational Codes

DOT Groups	HOC	DOT Groups	HOC	DOT Groups	HOC
001	AIR	090	SIA	191	ESC
2	IRE	1	SAE	3	RIE
3	IRE	2	SAI	4	RAI
5	RIE	4	SAI	5	SIC
6	IRE	6	SRI	6	IRC
7	RIE	7	SRE	7	EIR
8	IRE	9	SRE	8	RSE
				9	ICR
010	RIE	10	SAI		
1	IRE	11	EAS	201	CSE
2	ESI			2	CIE
3	RIC	12	SAI	3	CIE
4	RIC	13	AIS	4	CSE
5	IRA	141	AIS	5	CSE
7	RIA	2	AIS	6	CRS
8	RCI	3	AIR	7	CRI
9	RIE	4	AIR	8	CRI
		8	AIR	9	CIE
020	IRA	9	ASI		
1	IAR			210	CSI
2	IRA	150	ASE	1	CSI
3	IAR	1	ASE	2	CSI
4	IRA	2	ASI	3	CIS
5	IRA	3	SRE	4	CIS
9	IRA	9	AES	5	CIS
				6	CIR
040	RIS			7	CIS
1	IRS	160	CIS	9	CIS
5	SEC	1	CES		
9	ISR	2	ECS		
		3	ESC		
050	ECI	4	AES	221	CRE
1	SAI	5	AES	2	RIC
2	SEI	6	SEC	3	REI
4	SIA	8	SIE	4	RSE
5	IAR	9	ESC	9	CRI
9	SIA				
		180	ESC		
070	ISA	1	ERC	230	CSR
1	ISR	2	ERI	1	CRE
2	IRE	3	ESC	2	CRE
3	IRS	4	ESC	3	RCS
4	IES	5	ESI	4	CRS
5	SIA	6	ESC	5	CSE
7	SIE	7	SCE	6	CRS
8	ISR	8	ESC	7	CSE
9	SIR	9	ESC	9	RCS

Table 4 (Continued)

DOT Groups	HOC
240	RSC
1	SER
2	CSA
3	CSA
9	CSA
25	ECS
26	SER
270	SER
1	SER
3	SER
4	SER
5	SER
6	SER
7	SER
8	SEI
280	ESR
1	ESC
2	ESI
3	SEA
4	EIS
5	ESA
6	ESR
7	ESA
9	ESA
290	ESC
1	ESC
2	ESR
3	ESC
4	ESC
6	ESC
7	ESC
8	AIE
9	ESC
301	RCE
2	REC
3	RSE
4	RCI
5	RIS
6	REC
7	RES
9	RSE

DOT Groups	HOC
310	SEC
1	RSE
2	SEC
3	RIS
4	RIS
5	RIS
6	RSE
7	RSC
8	RSC
9	RSE
320	SRE
1	SRE
3	SRE
4	SER
9	SRE
330	RSE
1	SAC
2	SAC
3	ASC
4	SEC
5	SEC
8	SEC
9	SAC
34	RCS
350	ESR
1	ESR
2	ESA
3	SRI
4	SAI
5	SRI
6	SRI
7	SRE
8	SCE
9	SRE
36	RIC
371	RSC
2	RSE
3	RSE
5	RES
6	RES
7	RES
8	RIC
9	RES

DOT Groups	HOC
38	RSC
40	RIC
411	RIC
2	RIC
3	RES
9	RIC
42	RIC
43	RES
44	RIS
45	RIC
46	RIC
500	RIE
1	RIE
2	RIE
3	RIC
4	RIC
5	RIC
9	RIC
51	RSE
52	RIS
53	REI
54	RIC
550	RIC
1	RIC
2	RIC
3	RIC
4	RIC
5	RIC
6	RIC
7	RIC
8	RCS
9	RIC
56	RIC

Table 4 (Continued)

DOT Groups	HOC
57	RIC
58	RCE
59	RIC
600	RIE
1	RIS
2	RIC
3	RIC
4	RIC
5	RIE
6	RIC
7	RIC
9	RIC
610	RSE
1	RIE
2	RIE
3	RIC
4	RIS
5	RIE
6	RIE
7	RIE
9	RIE
62	RIE
630	RIC
1	RIS
2	RIC
3	RCI
7	REI
8	RIE
9	RIE
64	RIC
65	RIC
66	RIC
67	RIC
680	RCS
1	RCS
2	RCS
3	RSI
4	RSI
5	RSI
6	REC
9	REC
690	RIC
1	RIC
2	RIC
3	RAI
4	RCI
9	RCI
700	RIC
1	RIC
3	RIC
4	RIE
5	RIC
6	RIC
9	RIC
710	RIS
1	RIC
2	RIA
3	RIS
4	RIC
5	RIC
6	RIC
9	RIC
720	RIC
1	RIC
2	IRC
3	RIC
4	RIC
5	RIC
6	RIC
7	RIC
8	RIC
9	RIC

Table 4 (Continued)

DOT Groups	HOC
73	RIC
74	RIA
75	RIC
76	RIC
77	RIC
78	RCS
79	RCI
80	RIE
81	RIC
820	RIS
1	RIE
2	RIE
3	RIE
4	RIE
5	RIE
6	RIE
7	RIC
8	RIC
9	RIC
840	RCI
1	RCI
2	RCS
3	RCI
4	RCS
5	RCI
9	RCI
85	RCS
860	RIC
1	RCS
2	RIE
3	RIE
4	RIE
5	RIE
6	RIE
9	REI

DOT Groups	HOC
89	RIE
90	RCE
910	RES
1	RCS
2	RES
3	RSE
4	RCE
5	RSE
9	RIC
920	RES
1	RCE
2	RSE
9	RSC
93	RIC
94	RCI
950	RIS
1	RIC
2	RIC
3	RIE
4	RIE
5	RIE
6	RIE
7	RIE
9	RIE
960	RCI
1	AES
2	AEI
3	AEI
4	AEI
9	AES
970	AIR
1	AIR
2	AIR
3	RAI
4	RIC
5	RIC
6	AIR
7	RAI
9	AIR

NOTE: Teachers are assigned a code related to the subject they teach; e.g. Mathematics Teacher has DOT number 091.228, but preferably should be coded using the DOT number for Mathematics, 020.088.

Holland code for that group. However, some DOT groups were not coded in this manner, because they were not present in the Holland classification. Occupations which did not occur in the classification were coded using Holland's definitions of his categories so that all DOT groups were categorized into three-letter codes.

Testing the Conversion Methods

Methods I and II were tested by applying them to four occupational samples. The results are given in the upper half of Table 5.

Sample A is the 399 occupations from the revised Holland classification. For sample A, Method II yielded the best results: there was 85.0% agreement between the first letters of the Holland codes obtained by grouping and the first letters listed in the classification. Also, there was 64.7% agreement for all three letters of the Holland codes. Similarly, sample B, the ACT sample, yielded 89.0% agreement between the first letters obtained by grouping and the first letters listed in the ACT sample; the agreement for all three letters was 56.0%.

Because the data from samples A and B were used to create the translations, the results may be misleading. To apply an unbiased test to Methods I and II, two other occupational samples were taken from the DOT. Sample C consisted of 300 occupations, chosen from equi-spaced pages of the DOT; sample D consisted of 300 occupations from the Supplement to the DOT (1966), 50 from each of Holland's six categories. (Group designations shown in Table 3 were used to form sample D.) To form criteria for testing Methods I and II, each occupation in samples C and D was classified into a one-letter Holland code by three raters

Table 5

Some Tests and Comparisons of the Conversion Methods

	Samples Used to Develop Methods		Test Samples	
	399 Occupations from Holland Classification Sample A	91 ACT Occupations Sample B	300 DOT Occupations (Random) Sample C	300 DOT Occupations (50 each type) Sample D
METHOD I (Frequency)				
1st letter	73.2	69.3	90.0	57.9
1st 2 letters	34.1	33.0	-	-
3 letters	10.8	11.0	-	-
METHOD II (Grouping)				
1st letter	85.0	89.0	88.6	67.2
1st 2 letters	66.4	63.8	-	-
3 letters	64.7	56.0	-	-
	Agreement Between Methods I and II			
1st letter	74.5	67.1	89.0	53.0
1st 2 letters	34.6	42.9	26.0	24.9
3 letters	11.6	12.1	9.0	9.3

Note. All table entries are percentages. Chance agreement between 1st letters equals 16.7%; for 1st 2 letters equals 3.3%; for three letters equals 0.8%.

working independently. The interrater agreement for sample C was 90.1%, and for sample D it was 73.3%. Thus samples A and B consist of occupations which have been objectively classified into Holland categories, whereas samples C and D have been subjectively classified.

For sample C, a comparison between the codes obtained by Method I and by one rater yielded an agreement of 90.0%, and Method II yielded 88.6% agreement. (The agreements were not calculated for each rater because the interrater agreements for this sample were so high, 90.1%.) For sample D, a comparison between the codes obtained by Method I and three raters yielded an average agreement of 57.9%, whereas Method II yielded 67.2% agreement.

Comparisons of Holland codes obtained by Method I with those obtained by Method II are shown in the lower half of Table 5. To summarize, the data in Table 5 strongly suggest that Methods I and II yield similar results. Although both methods were devised from data (399 occupations and 91 occupations) which were used as a partial validation of the methods, the application of the methods to new samples of occupations (samples C and D) shows that both methods can be used for other occupational samples from the DOT.

Discussion

The good results obtained for samples A and B were to be expected, since the methods were developed using the samples themselves. A better test of the strength of both methods lies in the use of samples C and D, since they are chosen from the DOT itself. It is not surprising that the results for sample C are so good, since it is a

random sample of occupations from the DOT, and thus consists primarily of Realistic types of occupations. (It was found in this study that 81.5% of DOT occupations are Realistic.) These occupations are much easier to classify than some in other categories. For example, Pipe Cleaner is definitely a Realistic type occupation, whereas Production Man (Radio and TV) is strongly Enterprising and Artistic. Sample D contains 50 occupations of each type, and therefore contains more occupations which are difficult to classify. Thus one would expect the poorer results which were obtained. This difference in sample composition also explains why the interrater agreement was high (90.1%) for sample C, but much lower (73.3%) for sample D.

The frequency method rests on the assumption that DOT digit frequency patterns for the six Holland categories are sufficiently different to enable one to use them to find the Holland code corresponding to a given DOT number. The method might be more useful in future work if a larger sample of occupations are used to form the frequency distributions. Since the frequency method is formed objectively, according to Bayesian statistics, it can be a powerful tool for further research. In contrast, although more subjective, the strength of the grouping method lies in the fact that it can be used so easily; one has merely to look up the Holland code in Table 4. Since both methods agree well with one another, either can be used.

The errors for both methods were largely the kind one would predict from the relationships among the categories in the classification. Many Realistic occupations were found to be Investigative by both methods, and vice versa. Similarly, reversals frequently

occurred between Social and Enterprising types of occupations. This would be expected since there is a moderate correlation between Investigative and Realistic components and between Social and Enterprising components (Holland, et al, 1969).

The methods described in this paper are superior to the subjective method of sorting of occupations which users have had to resort to because they lacked practical, explicit criteria. This extension of Holland's classification to all DOT occupations makes the classification truly comprehensive. However, this extension is an approximation obtained by a series of indirect techniques. Consequently, the use of either Method I or II to classify occupations will have less validity and reliability than is ideal. Ideally, an occupation should be classified by testing representative occupational groups of persons with the Vocational Preference Inventory (Holland, 1965), or with the Self-directed Search (Holland, 1970). Because extension of the classification in this way is impracticable, it will be necessary to continue to use these indirect techniques.

The use of occupational profiles based on the VPI is the preferred method for translating an occupation from the DOT into the appropriate Holland code. If these data are not available, then the classification by Holland, Viernstein, Kuo, Karweit and Blum (1970) should be considered next. And, if the occupation is not listed in that classification, then the grouping or frequency methods should be used.

Despite the limitations of these new methods, Holland codes can now be found for all occupations listed in the DOT, so that the practical and theoretical possibilities of the classification can be

further explored. The fact that this type of translation is possible and can be done well illustrates the strong relationship between Holland's classification and the Dictionary of Occupational Titles classification.

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